ISSN 1068-798X, Russian Engineering Research, 2017, Vol. 37, No. 8, pp. 728–729. © Allerton Press, Inc., 2017.
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Cutter Profile of a Mill for Machining Screw Channels

S. M. Petrov*, G. K. Davletshina, B. F. Zairov, and L. F. Zairov

Naberezhnye Chelny Institute, Kazan (Volga Region) Federal University, Naberezhnye Chelny, Russia
**e-mail: kpfu.ktomp@yandex.ru*

Abstract—A method is proposed for determining the cutter profile of a mill.

Keywords: coordinates, profile, mill, cutter
DOI: 10.3103/S1068798X17080147

Two methods may be used select the disk tool for machining a screw surface when preparing for the manufacture of a new product.

1. Design a special new tool. This includes the following steps.

1.1. Determination of the parameters, the profile, and the mathematical and computer models of the helical surface.

1.2. Selection of the dimensions of the disk tool.

1.3. Determination of the parameters of tool–workpiece setup.

1.4. Identification of the points on the tool profile corresponding to characteristic points of the workpiece profile.

1.5. Verification: determination of the workpiece profile from the selected tool profile and its comparison with the profile specified on the drawing.

1.6. Manufacture and testing of a prototype.

1.7. Preproduction and production of the new tool in the required quantities.

A deficiency of this method is that preproduction is particularly lengthy and the overall production costs are correspondingly increased.

2. The use of a standard or preexisting tool available at the plant. That eliminates the design, preproduction, and production of a new tool. In this case, attention focuses on the selection of the optimal tool.

The initial step in tool selection is computer simulation of the machining of a helical surface. The initial data consist of the manufacturing parameters and drawings of the product and the tool.

The steps employed in simulation of the machining process are as follows.

1. Mathematical description of the tool's surface geometry and computer simulation of the tool.

2. Mathematical and computer simulation of the machining of the product's helical surface by the tool, to obtain a family of curves representing the helical projection of intersections of the tool surface by secant planes [1, 2].

3. Determination of the envelope of this family of curves and its comparison with the initial cross section of the part.

These stages represent a hierarchy of problems. The solution of one problem provides the initial data for the next.

The initial data for mathematical description of the cutter profile are the following parameters (with allowance for the tolerance $\pm\Delta$): the mill radius $R_{mi} \pm \Delta$; the mill width $B \pm 2\Delta'$; the arc radius at the tip $r \pm \Delta$; the distance from the axis O_tX_t to the end of the mill $B_1 \pm \Delta'$, which is used to machine the front surface; the inclinations θ_1 and θ_2 of the linear sections of the cutter profile.

The mill's cutter profile is a complex curve, which cannot be described by a single analytical expression. Therefore, it may expediently be divided into elementary sections. In the present case, the tool profile has three sections, as shown in the Fig. 1: two linear sections and one curved section, which may be approximated by an arc of a circle.

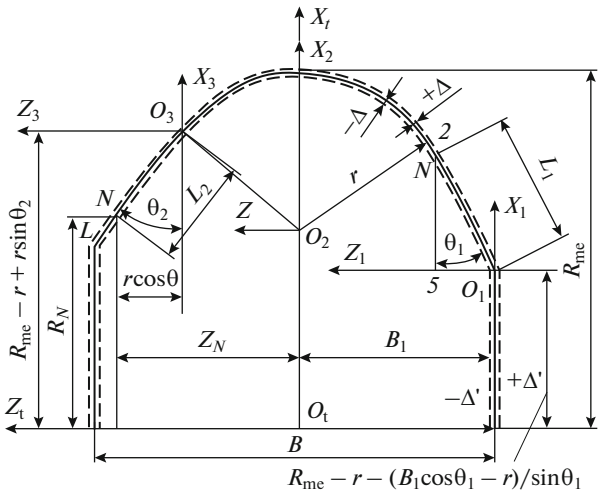

Fig. 1. Description of the tool profile.